CLAIM(S):

1. A bulk material irradiation system comprising:

an input for inserting bulk material;

a bulk material tube connected to the input and forming a path for bulk material flow;

a pumping assembly connected to the bulk material tube for forcing the bulk material to advance through the bulk material tube;

an irradiation assembly providing ionizing radiation that penetrates a full thickness of the bulk material to irradiate the bulk material passing adjacent to the irradiation assembly in the bulk material tube; and

an output for irradiated bulk material to exit the bulk material tube.

2. The bulk material irradiation system of claim 1, wherein the irradiation assembly is operable to provide ionizing radiation to irradiate the bulk material passing adjacent to the irradiation assembly in the bulk material tube from two opposite sides.

3. The bulk material irradiation system of claim 1, wherein the irradiation assembly comprises:

a source of ionizing radiation;

a conduit for providing a radiation propagation path between the source of ionizing radiation and the bulk material tube;

a foil between the conduit and the bulk material in the bulk material tube; and

a gas flow path adjacent to the foil opposite the bulk material tube for receiving a flow of gas pressurized to a level

approximately equal to a level of pressurization in the bulk material tube.

4. The bulk material irradiation system of claim 3, further comprising:

a sensor for measuring the level of pressurization in the bulk material tube; and

a gas flow adjustment mechanism for adjusting the pressurization of the gas flow in the gas flow path to maintain the level of pressurization of the gas flow path approximately equal to the level of pressurization in the bulk material tube.

5. The bulk material irradiation system of claim 3, further comprising:

a carrier frame rigidly attached to the bulk material tube, the foil being bonded to the carrier frame.

6. The bulk material irradiation system of claim 1, wherein the at least one bulk material tube comprises a plurality of bulk material tubes each offset from adjacent tubes in an alternating pattern.

7. The bulk material irradiation system of claim 1, wherein the bulk material tube is composed of titanium and a laminate layer for contacting bulk material on an inner surface of the bulk material tube.

8. The bulk material irradiation system of claim 7, wherein the laminate layer is composed of stainless steel.

9. The bulk material irradiation system of claim 1, further comprising:

a dosimetry carrier entry port in the bulk material tube upstream from the irradiation module; and

a dosimetry carrier exit port in the bulk material tube downstream from the irradiation module.

10. The bulk material irradiation system of claim 9, wherein the dosimetry carrier entry port and the dosimetry carrier exit port are configured to receive a dosimetry carrier having a shape conforming to an inner circumference of the bulk material tube.

11. The bulk material irradiation system of claim 9, wherein the dosimetry carrier exit port is movable between a first position for allowing bulk material to pass through the bulk material tube and a second position for diverting a flow of bulk material away from the bulk material tube into a waste area.

12. The bulk material irradiation system of claim 1, wherein the bulk material tube is elliptical in shape and has a wall with a thickness that is thicker around edge portions of the bulk material tube than around a central portion of the bulk material tube.

13. The bulk material irradiation system of claim 1, further comprising a liquid around the wall of the bulk material tube.

14. The bulk material irradiation system of claim 1, wherein the bulk material tube has an outer wall that is rectangular in shape and an inner wall that is elliptical in shape, a region between the outer wall and the inner wall including a

liquid with an irradiation absorption characteristic that approximately matches an irradiation absorption characteristic of the bulk material in the bulk material tube.

15. The bulk material irradiation system of claim 1, wherein the bulk material is a liquid.

16. A bulk material irradiation system comprising:

bulk material transport means forming a path for bulk material flow;

bulk material pumping means for forcing the bulk material to advance through the bulk material transport means; and

irradiating means for providing ionizing radiation that penetrates a full thickness of the bulk material to irradiate the bulk material as it passes through the bulk material transport means.

17. A fresh ground meat irradiation system comprising:

an input for inserting fresh ground meat;

a conduit connected to the input and forming a path for the ground meat to flow;

a pumping assembly connected to the conduit for forcing the ground meat to advance through the conduit;

an irradiation assembly providing ionizing radiation that penetrates a full thickness of the ground meat in the conduit to irradiate the ground meat passing adjacent to the irradiation assembly in the conduit; and

an output for irradiated ground meat to exit the conduit.

18. The fresh ground meat irradiation system of claim 17, wherein the ground meat fills substantially all of an interior volume of the conduit.

19. The fresh ground meat irradiation system of claim 17, further comprising a velocity measurement system for determining an actual rate of ground meat movement through the conduit and adjusting an irradiation dose provided by the irradiation assembly based on the determined rate.